

New Orleans, La., where it was highest on the 6th, and Portland, Oreg., where the river was highest on the 30th and still rising. The high water at Shreveport and Vicksburg was largely due to the floods of the 18th to the 21st of March in Arkansas.

NAVIGATION OF RIVERS AND HARBORS.

The following special reports relative to ice and navigation have been received:

Detroit River.—Detroit, Mich., 1st, navigation on the lower Lakes was opened to-day.

Mississippi River.—St. Cloud, Minn., 6th, clear of ice.

Missouri River.—Sioux City, Iowa, 1st, very high and full of ice.

Lake Erie.—Buffalo, N. Y., 1st, navigation opened.

Lake Michigan.—Green Bay, Wis., 1st, the first boat of the season left port. Chicago, Ill., 1st, navigation opened.

Lake Ontario.—Rochester, N. Y., 1st, navigation opened.

Lake Superior.—Sault Ste. Marie, Mich., 17th, navigation opened. Duluth, Minn., 18th, navigation opened.

OBSERVATIONS ON THE GREAT LAKES.

REPORTS FROM VESSELS.

Navigation having opened about April 1, the Lake Marine Section of the Forecast Division has received reports from the captains of eighteen vessels navigating the Great Lakes. The following miscellaneous items are extracted from their reports:

Capt. H. Zealand, steamship *Simon Lanzell*, April 24, central part of Lake Huron: Aurora began 8.30; very bright and dancing at 11 p. m.; receded at midnight. April 25, 7.50 p. m., we sighted, by the help of mirage, Stannard Rock Light, which was distant 58 miles by chart measurement. We were on course from Whitefish Point to Manitou Island and had Caribou Island abeam. Aurora began at 9.10; quit at 10.45.

Capt. A. B. Drake, steamship *Thomas Maythan*, April 25, 12.30 a. m., Stannard Rock Light not lighted.

NOTE.—Capt. Zealand's hypothesis that the light was visible by the help of mirage, assumes, of course, that he was correct in estimating his own location. Capt. Drake's statement that this light was not lighted at 12.30 a. m. should be taken in connection with the possible existence of "mirage," since the same optical phenomenon that causes the light to be visible to distant vessels may cause it to be invisible to nearer vessels. In general, the noise from the fog horn and the light from a lighthouse are equally subject to the laws of irregular refraction and reflection by the atmosphere.

Capt. Edward Mooney, steamship *Wa-Wa-Tarn*, April 12, Milwaukee, aurora borealis display.

Capt. W. P. Robertson, steamship *Petroskoy*, April 24, Chicago, aurora borealis from 10 p. m. onward.

Capt. C. H. Lewis, steamship *John C. Gault*, April 12, Lake Erie, N. 52° 50', W. 82°, 9.45 p. m., aurora very bright, bearing north-northwest to northeast; died out at 10.30 p. m.

Capt. W. A. Russell, steamship *William A. Proctor*, April 17, Ogdeensburg, northern lights lasting about one-half hour. April 17, 12 miles west of Clayton, St. Lawrence River, 6 a. m., buoy in St. Lawrence not yet placed. 22d, 7.45 a. m., no buoy on Galloo Shoal.

REPORTS FROM U. S. LIFE-SAVING STATIONS.

Through the kind co-operation of the General Superintendent of the Life-Saving Service and the Secretary of the Treasury, the Weather Bureau has received 14 weekly transcripts of journals for the month of April from the keepers of 4 Life-Saving Stations on the Great Lakes. The following special notes by the respective keepers are extracted from these journals:

Middle Island, Lake Huron.—Donald McKenzie, keeper. April 12, northern lights to-night very brilliant from about 8 p. m. to midnight; 24th, northern lights 10 p. m. to midnight; 26th, northern lights 9.30 p. m. to midnight.

WRECKS ON THE GREAT LAKES.

The Weather Bureau has published a special report, with chart, showing the location of wrecks that have occurred on the Great Lakes during the years 1886-'93, inclusive. This report and chart show 227 wrecks, with a loss of 420 lives, and about \$5,000,000 of property, distributed as follows: Lake Superior, 32 vessels; Lake Michigan, 85; Lake Huron, 44; Lake Erie, 50; Lake Ontario, 16. Of ten important wrecks that occurred during the years 1892 and 1893, seven occurred during stormy conditions, of which timely warning had been given by the Weather Bureau, and of the remaining three, two were due to fog.

The present editor notes that a remarkably small proportion of these wrecks seem to have occurred near large ports; thus, on Lake Superior, near Duluth and Marquette, only 2 are located; on Lake Michigan, near Chicago, Milwaukee, and Grand Haven, 4; on Lake Huron, near Port Huron, Saginaw, and Alpena, 3; on Lake Erie, near Toledo, Sandusky, Cleveland, Erie, Dunkirk, and Buffalo, 12; on Lake Ontario, near Oswego, 6. In all, 27 out of 226.

SUNSHINE AND CLOUDINESS.

GENERAL REMARKS.

The quantity of sunshine, and probably of heat, received by the atmosphere above the cloud layer, is very nearly constant from year to year, but varies with the day and month. On the other hand, at the surface of the earth, the distribution of sunshine and, therefore, the resultant heat with its meteorological and biological consequences depends mostly on the distribution of cloudiness.

The *sunshine* is recorded automatically, either by its photographic or its thermal effects. The *cloudiness* is recorded by personal observations by the local observers.

SUNSHINE.

During the month an instrumental record of sunshine has been kept at 16 stations by means of the photographic sunshine recorder and at 21 stations by means of the thermometric sunshine recorder; the results of these observations are given in Table IV, which shows the actual percentage of sunshine received on the average of the month for any hour of local mean time (not seventy-fifth meridian mean time).

The stations recording the largest percentage of sunshine between the hours of 11 a. m. and 1 p. m., are: Baltimore, Md., 86; Colorado Springs, Colo., 91.5; Key West, Fla., 98; San Francisco, Cal., 87.5; Tucson, Ariz., 91.5; Vicksburg, Miss., 87.5.

The stations having the least percentage during these hours are: Bismarck, N. Dak., 45; Portland, Oreg., 45.5.

The general average sunshine for the whole month is given in the next to the last column of Table IV. The highest percentages are: Key West, Fla., 91; Tucson, Ariz., 86; Santa Fe, N. Mex., 79; San Francisco, Cal., 75.

The lowest percentages are: Portland, Oreg., 37; Bismarck, N. Dak., 47; Boston, Mass., 51; Des Moines, Iowa, 52.

CLOUDINESS.

The number of clear and cloudy days and the average cloudiness between sunrise and sunset, as based on numerous personal observations, are given for each Weather Bureau station in Table I. The complement of this average cloudiness gives the observer's estimated percentage of clear sky, and these

latter numbers are given in the last column of Table IV. On the average these personal estimates of clear sky are lower than the sunshine as recorded by the self-registers.

COMPARISON OF RECORDS.

The duration of direct sunshine is the quantity shown by the self-recording photographic or thermometric sunshine registers; the percentage of area of clear sky is the quantity shown by the complement of the observer's estimate of cloudiness. It is sometimes assumed that these numbers should agree but, as has been explained in previous REVIEWS, the relation between these numbers is rather complex; in general, the monthly averages agree best in cloudy climates and may differ widely in clear climates. In the following table the instrumental record for April and the observer's estimate for April are brought together, side by side, and in accordance with the results of previous months it is seen that the instrumental percentages of duration of sunshine are almost always larger than the observer's personal estimates of percentages of area of clear sky:

Difference between instrumental and personal observations of sunshine.

Photographic stations.	Instrumental.	Personal.	Difference.	Thermometric stations.	Instrumental.	Personal.	Difference.
Tucson, Ariz.....	86	78	8	Key West, Fla.....	91	73	18
Santa Fe, N. Mex.....	79	65	14	Colorado Springs, Colo.....	70	51	19
San Francisco, Cal.....	75	72	3	Vicksburg, Miss.....	68	55	13
Dodge City, Kans.....	74	66	8	Little Rock, Ark.....	68	52	16
Savannah, Ga.....	73	57	16	Baltimore, Md.....	67	54	13
Denver, Colo.....	68	56	12	Chicago, Ill.....	64	51	13
Memphis, Tenn.....	67	66	1	Wilmington, N.C.....	63	54	9
Kansas City, Mo.....	61	54	7	Philadelphia, Pa.....	62	50	12
Helena, Mont.....	60	49	11	Salt Lake City, Utah.....	62	48	14
Galveston, Tex.....	59	58	1	Columbus, Ohio.....	60	42	18
Washington, D. C.....	57	56	1	New York, N. Y.....	58	47	11
Cleveland, Ohio.....	57	47	10	Portland, Me.....	58	39	19
Cincinnati, Ohio.....	56	50	6	New Haven, Conn.....	57	48	9
Bismarck, N. Dak.....	47	46	1	Rochester, N. Y.....	56	51	5
Portland, Ore.....	37	33	4	Buffalo, N. Y.....	56	47	9
San Diego, Cal.....	60	.....	.....	Detroit, Mich.....	55	45	10
Eastport, Me.....	33	.....	.....	Des Moines, Iowa.....	52	46	6
				Boston, Mass.....	51	42	9
				New Orleans, La.....	55	.....	.....
				St. Louis, Mo.....	54	.....	.....
				Louisville, Ky.....	54	.....	.....

NOTES BY THE EDITOR.

OBSERVATIONS AT HONOLULU, HAWAIIAN ISLANDS.

Meteorological observations at Honolulu, Hawaiian Islands, for April, 1894, by Curtis J. Lyons, Meteorologist to the Government Survey.

Date.	Barometer at sea level.			Temperature.					Humidity.			Wind.		Rain to 6 p. m.
	9 a. m.	3 p. m.	9 p. m.	6 a. m.	2 p. m.	9 p. m.	Minimum.	Maximum.	Relative.		Absolute.	Direction.	Force.	
									9 a. m.	9 p. m.				
1.....	Ins.	Ins.	Ins.	69	75	69	67	77	Pr. ct.	Pr. ct.	55	ne.	Ins.	
2.....	30.20	30.12	30.18	62	76	71	61	78	65	73	58	e. ne.	0.00	
3.....	30.18	30.11	30.18	68	75	65	65	78	64	72	59	ne.	0.00	
4.....	30.17	30.09	30.16	68	76	67	63	79	66	73	59	ne.	0.00	
5.....	30.14	30.00	30.15	68	76	67	63	79	65	79	59	ne.	0.00	
6.....	30.12	30.03	30.14	65	77	70	63	80	62	76	59	se.	0.00	
7.....	30.12	30.07	30.15	67	78	68	63	79	70	85	56	se.	0.00	
8.....	30.12	30.05	30.14	63	77	69	62	80	70	80	54	n. s.	0.00	
9.....	30.12	30.05	30.13	63	79	70	63	82	70	79	56	s.	0.00	
10.....	30.14	30.08	30.13	71	78	73	68	80	63	70	53	ne.	0.00	
11.....	30.12	30.05	30.12	72	76	72	68	78	66	65	50	ne.	0.00	
12.....	30.10	30.03	30.12	72	77	71	71	79	66	77	51	ne.	0.00	
13.....	30.08	30.06	30.16	71	74	72	71	78	75	75	53	ne.	0.10	
14.....	30.17	30.10	30.14	70	75	72	70	79	65	74	53	ne.	0.06	
15.....	30.15	30.06	30.10	71	76	71	70	78	62	73	51	ne.	0.05	
16.....	30.08	30.00	30.07	68	76	71	67	79	66	70	51	ne.	0.14	
17.....	30.08	30.00	30.07	79	77	70	67	79	66	75	51	ne.	0.12	
18.....	30.10	30.04	30.11	70	75	71	68	77	73	77	54	ne.	0.26	
19.....	30.11	30.01	30.08	68	75	72	68	75	80	77	50	ne.	0.26	
20.....	30.07	30.04	30.12	72	76	72	71	78	77	79	50	ne.	0.18	
21.....	30.15	30.13	30.18	71	75	72	70	77	75	70	55	ne.	0.18	
22.....	30.22	30.16	30.22	71	75	70	71	77	63	74	58	e. ne.	0.05	
23.....	30.22	30.14	30.22	69	76	69	67	78	63	80	59	ne.	0.02	
24.....	30.19	30.12	30.20	68	72	69	66	75	69	75	59	ne.	0.48	
25.....	30.20	30.14	30.22	68	74	71	67	76	60	69	56	ne.	0.18	
26.....	30.22	30.14	30.21	70	75	71	67	76	61	60	56	ne.	0.15	
27.....	30.19	30.15	30.23	71	73	71	70	76	66	74	50	ne.	0.01	
28.....	30.20	30.14	30.16	69	75	71	68	75	73	75	50	ne.	0.12	
29.....	30.12	30.05	30.16	71	77	70	70	78	68	69	53	ne.	0.05	
30.....	30.14	30.10	30.16	68	73	72	66	81	77	84	71	ne., sw.	2, 0	
30.....	30.14	30.05	30.14	70	79	72	68	81	77	79	71	sw.	1	

Dark, overcast weather, but little rain at the end of April and the beginning of May. Hail at Hawaii 24th of April.

The barometer is corrected for temperature and reduced to sea level, but the gravity correction, -0.06, is still to be applied.

The absolute humidity is expressed in grains of water, per cubic foot, and is the average of four observations.

The rain is measured at 6 p. m., daily.

OBSERVATIONS IN ALASKA.

Mr. H. S. Tibbey, observer at Coal Harbor, Unga Island, Alaska, N. 55° 20' 45", W. 164° 38' 39", altitude 30 feet, sends the following notes with regard to special phenomena. The hours quoted by him are evidently local time, civil reckoning:

January 16, 7.10 a. m., slight shock of earthquake, vibrations northeast to southwest.

January 17, 3.45 a. m., slight shock of earthquake, vibrations northeast to southwest.

January 30, high wind commenced southerly early in the morning, rate 17

miles per hour, increased to 28 and reached 72 miles from 4 to 6 p. m. Hauled to southwest, blowing 33 miles till 2 p. m., next day, when it gradually abated to a gentle breeze.

February 8, 4 p. m., wind from northwest, increased to 37 miles per hour. Barometer having risen rapidly to 30.50, began falling rapidly. Wind culminated between 8 and 9 a. m. on the 9th, blowing 60 miles per hour; then shifted to north-northeast and northeast, gradually decreasing to 35 and 23 miles; hauled to the northwest and became normal. Barometer stopped falling at 29.44, at 2 p. m., 9th. During the disturbance, as soon as the wind left the northwest, the thermometer jumped from 6° to 29°, and continued fluctuating until the wind settled back again to the northwest.

March 17, during the daytime it was almost calm; at about 9 p. m. the wind shifted from southwest to southeast, freshened rapidly, increasing during the night from 15 miles per hour until noon of the 18th, when it culminated at 90 miles per hour, accompanied by light showers, fine snow, and occasional hail. By 4 p. m., wind velocity declined to 40 miles per hour; hauling, meanwhile, to southwest and blowing in squalls, with fine snow; averaged 20 miles per hour till 8 a. m., of the 19th, when it passed more to the westerly and became normal. The barometer fell from 30.07, at 2 p. m., 17th, to 29.40 at 7 a. m., 18th, when it commenced to rise and reached 29.98 at 7 a. m., 19th. Thermometer fluctuated from 35° to 12° during the storm.

RAINFALL IN TEXAS.

Rainfall observed near Golinda, Falls Co., Tex., by Mr. E. G. Hanrick.

(Approximate location, N. 31° 20'. W. 97°; altitude, 500 feet.)

Month.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.	1892.	1893.
	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.
January.....	0.50	1.00	1.75	1.25	6.20	1.75	0.00	2.90	6.75	2.75	6.90	1.90	1.00
February.....	3.75	7.10	3.50	2.75	0.70	3.50	0.00	5.25	5.20	2.50	1.15	1.50	0.65
March.....	1.25	4.10	5.25	1.10	2.40	1.50	0.00	4.70	0.60	5.15	1.00	2.55	3.40
April.....	3.25	1.00	0.25	8.85	5.50	5.10	1.90	3.95	2.10	7.55	7.00	1.50	3.00
May.....	3.00	6.00	0.25	9.50	12.25	0.10	3.60	4.10	3.20	5.50	0.30	4.65	4.50
June.....	0.00	0.00	2.75	0.35	2.00	2.00	1.05	3.95	8.25	3.10	2.10	1.05	4.00
July.....	1.50	6.50	2.00	1.35	1.50	2.75	1.20	2.00	0.80	1.85	1.35	0.90	1.00
August.....	3.50	4.00	0.00	0.00	0.10	0.55	2.35	5.75	1.10	1.60	3.50	4.60	3.15
September.....	4.50	5.50	1.00	0.75	5.95	6.50	2.50	1.00	5.80	5.20	0.80	0.20	0.50
October.....	9.75	5.50	0.50	3.75	1.50	1.00	1.80	2.25	0.40	5.10	0.60	3.20	0.00
November.....	2.75	6.50	1.35	1.90	1.50	1.20	3.00	5.85	4.95	2.90	2.50	1.80	3.95
December.....	2.25	0.00	2.50	3.50	2.25	0.00	2.65	4.30	0.00	0.25	5.15	5.20	0.70
Total.....	36.00	57.20	21.70	35.05	41.85	25.95	20.05	46.00	39.15	43.45	32.35	29.05	22.15

General average of 13 years, 34.61 inches annually.

THE WEIGHT OF SNOW.

In connection with the heavy snowfall of April 10 and 14, in Pennsylvania, a correspondent records the fact that at Nittany, in central Pennsylvania, N. 41°, W. 77° 40', the amount of snow that fell on the platform scales at that place weighed 1,640 pounds; as the platform was 8 by 12 feet, or 96 square feet in area, this gives an average weight of about 17 pounds to a square foot, which is equivalent to a depth of 3.3 inches of water, and using the ordinary ratio, 10, this gives a corresponding depth of 33 inches of snow.